BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 April 2001 (26.04.2001)

PCT

(10) International Publication Number
WO 01/29848 A1

(51) International Patent Classification⁷: H01B 7/18

(21) International Application Number: PCT/GB00/03956

(22) International Filing Date: 16 October 2000 (16.10.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
9924411.3 16 October 1999 (16.10.1999) GB

(71) Applicant (*for all designated States except US*): RAYDEX/CDT LTD. [GB/GB]; Gladden Place, West Gillibrands, Skelmersdale, Lancashire WN8 9SX (GB).

(72) Inventor; and

(75) Inventor/Applicant (*for US only*): PRESCOTT, Stephen, John [GB/GB]; 1 Pine Grove, Hartwood Park, Chorley, Lancashire PR6 7BW (GB).

(74) Agents: GOODWIN, Mark et al.; Wilson Gunn M'Caw, 41-51 Royal Exchange, Cross Street, Manchester M2 7BD (GB).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

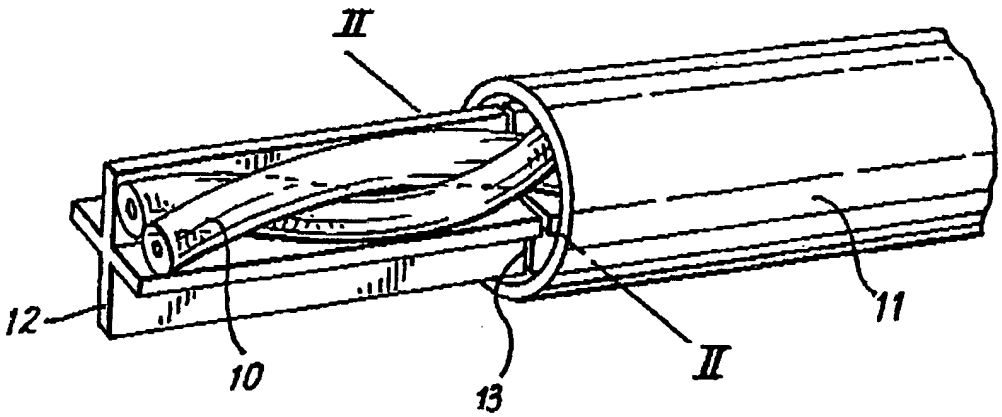
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

- *With international search report.*
- — *Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: CABLES INCLUDING FILLERS



(57) Abstract: A cable includes a filler (12) including a plurality of points of weakness (13) or discontinuities spaced along its length. The points of weakness or discontinuities may be evenly spaced along the length of the cable and may be formed by partially or fully cutting through the filler. The filler may be formed from a plastics material and may be shaped, in cross section, to have a number of arms to enable it to separate other components of the cable. The filler may be electrically conductive or semi-conductive to enable it to act as screen between other components of the cable.

WO 01/29848 A1

CABLES INCLUDING FILLERS

The present invention relates to cables including fillers.

It is common for electrical and optical cables to include a filler or multiple fillers. Fillers typically comprise string or extruded plastic components which occupy space within the cable. They may be provided to enhance the overall shape of and/or positioning of other components, for example conductors or optical fibres, relative to each other within the cable, or to provide mechanical protection. For example a central filler may be surrounded by cable components or interstitial fillers may be provided between cable components to give a cable a substantially circular cross-section.

Where a cable is terminated, for example in a connecting device, the filler is normally redundant or superfluous. In many cases, the filler is of nuisance value to the installer who has to perform what is perceived as the extra task of removing it prior to terminating the cable. In some cable and connector designs where space limitation, connection procedures, or specific performance requirements dictate, the task can be difficult to achieve satisfactory and/or safely.

The problem of filler removal is particularly acute with the type of cables used for high speed data transmission. One design of cable employs four pairs of twisted insulated copper wires surrounding an extruded plastic filler element of cross-shaped cross-section. The filler serves to separate

the twisted pairs to reduce the amount of signal interference ("crosstalk") between them. Crosstalk is also reduced by careful selection of a different twist pitch for each element. The twisted pairs and filler are surrounded by an outer sheath.

Such cable is typically terminated in small connectors such as the industry standard RJ45-type. Making an interface between cable and connector requires great care by the installer to ensure that components combine in an effective manner to give a high performance connection. To achieve this some of the cable sheath must be removed to expose the wires, and the filler removed to the point of the cable sheath so that it does not interfere with the termination procedure or quality. To achieve this, the twisted pairs need to be displaced or folded back so that the filler can be cut.

This procedure has two major drawbacks. Firstly, the construction of the twisted pair is extremely precise in all respects. Disturbing the integrity of the twisted pair by displacement, bending, untwisting or other mechanical disturbance, may reduce cable performance significantly and irreparably. Secondly, installation engineers wish to minimise the number of steps and the time involved in each termination, and removal of such components can be awkward, time consuming and therefore costly.

It is an object of the present invention to reduce the problems associated with conventional cables incorporating fillers, especially cables

used for high speed data transmission.

According to a first aspect of the present invention there is provided a cable comprising a filler having a plurality of points of weakness or discontinuities spaced along its length.

The provision of points of weakness or discontinuities enables a portion of filler to be removed from the cable without the need for cutting. To remove a portion the filler is placed under tension, for example by pulling with finger and thumb or pliers. The filler can then be withdrawn from the cable up to the nearest discontinuity or point of weakness at which the filler will preferentially break. Since sharp tools are not required there is a reduced risk of accidental cable damage and personal injury.

It is preferred that the points of weakness or discontinuities are evenly spaced. The spacing may be made consistent with the intended requirements for connectorizing or terminating a particular cable. The spacing may also be consistent with avoiding signal reflections in the operating frequency range. In one embodiment the points of weakness or discontinuities lie at intervals of between 10 and 50mm.

The outside of the cable may be marked to indicate the locations of the points of weakness or discontinuities in the filler.

Points of weakness may be formed by partially cutting through the filler. In one arrangement points of weakness are formed by perforating the filler. Points of weakness could also be formed by varying the cross-section

or composition of the filler or strength of the filler in some other way, for example during extrusion of a plastic filler.

Preferably, the filler is formed from plastics material. Suitable non-electrically conductive materials include polyethylene, polypropylene and PVC. Such a filler may be formed by extrusion. The filler is preferably disposed to separate two or more cable components. Preferably the filler is shaped, in cross-section, to have a number of arms, for example four to form a cross shape to enable it to separate other cable components. The filler is preferably flexible.

The cable preferably comprises a plurality of cable components.

Preferably, the cable components comprise a plurality of twisted pairs of insulated wires and each pair is separated from each other pair by the filler. The number of pairs of wires preferably corresponds to the number of arms of the filler.

Separating the pairs of wires helps to reduce the amount of crosstalk between them. To further reduce crosstalk an electromagnetic screen may be provided around one or more of the pairs for example by wrapping the pair with a conductive tape, for example a metal tape or tape laminate. An aluminium/polyester laminate would be suitable.

As an alternative, or to further reduce crosstalk, a further preferred feature of the invention is that the filler comprises some electrically conductive or semi-conductive material. This enables the filler to act as an

electromagnetic screen. The filler is preferably formed from a conductive plastics material, for example a semi-conductive polymer.

The filler may be formed from a foamed material.

The cable filler and components are preferably disposed within an outer sheath. They may also be surrounded by tapes, foils, laminates, braids and other components, for electromagnetic screening or mechanical protection.

The invention provides for the production of cables for high speed data transmission which may be more quickly, easily, safely and reliably installed than conventional cables.

According to a second aspect of the present invention there is provided a method of manufacture of a cable comprising the steps of providing a filler and partially or wholly cutting through the filler at points along its length to form points of weakness or discontinuities along its length.

Preferably, the method also comprises the step of encapsulating the filler together with other cable components in an outer sheath.

According to a third aspect of the present invention there is provided a method of preparing a cable according to the first aspect of the present invention, with or without any of the subsequently discussed optional features of that aspect, for installation, comprising the step of pulling on the filler to remove a portion of the filler up to a point of weakness or

discontinuity.

Preferably the filler is removed up to the first point of weakness or discontinuity from the point at which it is pulled. The cable preferably includes an outer sheath and the method preferably further comprises the step of stripping off a portion of the outer sheath to expose a portion of the filler at the end of the cable, which portion can then be pulled to remove a portion of the filler.

In order that the invention may be more clearly understood embodiments thereof will now be described by way of example with reference to the accompanying drawings in which:-

Figure 1 shows a perspective view of one embodiment of a cable according to the invention with part of its outer sheath stripped away to reveal a filler and of one of four twisted pairs of cable;

Figure 2 shows a cross-sectional view of the cable of Figure 1, taken along the line II-II;

Figure 3 shows a cross-sectional view through another embodiment of a cable according to the invention;

Figure 4 shows a side view of another embodiment of a cable according to the invention with some of its outer sheath stripped away to reveal a filler and cable components;

Figure 5 shows an enlarged cross-sectional view of the cable of Figure

4, taken along the line V-V; and

Figure 6 shows a schematic view of apparatus for introducing points of weakness into a cable filler.

Referring to Figures 1 and 2 a cable comprises four pairs of twisted insulated electrical wires 10 (only one of which is shown in Figure 1, for clarity) disposed in a plastic outer sheath 11. Also disposed in the outer sheath 11 is a cable filler 12 comprising an electrical grade polyethylene extrusion the cross section of which is cross-shaped with four substantially perpendicular arms which divide the space within the outer sheath 11 into four regions. The four pairs of wires 10 are respectively disposed in these regions. The filler 12 gives the cable structure as well as separating the four pairs of twisted wires 10 to reduce crosstalk between them.

In an alternative embodiment the filler 12 is formed from an electrically conductive material and therefore provides an electromagnetic screen between each twisted pair. This embodiment is capable of producing extremely low values for crosstalk over a wide frequency bandwidth.

At regular intervals along its length each arm of the filler 12 has been partially cut through to provide a point of weakness 13 at which the filler 12 will preferentially break when placed under tension.

The cable is shown with a portion of its outer sheath 11 removed, to expose the wires 10 to enable them to be fitted into a connector to

terminate the cable. To correctly terminate the cable, for example with an industry standard RJ45 connector, to provide a connection which does not impair the performance of the system of which the cable forms part it is necessary to remove the exposed filler 12, back to the sheathed section of cable, but to leave the wires 10 in tact.

Conventionally it would be necessary to fold back the twisted wire pairs 10 and cut the filler 12. Disturbing the integrity of the twisted pairs 10 may reduce cable performance significantly, particularly with cables of the illustrated type which can support data transmission of digital information at rates of the order of 1G bit/s and above. When cutting the filler there is also a risk of damaging the cable.

However, with the illustrated cable all that is required is to grip the end of the filler 12 and pull it away from the cable. The filler 12 will then break at the first point of weakness 13, within the cable sheath 11, without disturbing the wires 10.

The distance between the points of weakness is sufficient so that the filler is accessible so as to facilitate gripping with finger and thumb or small tools.

Figure 3 shows an alternative embodiment. Referring to this Figure, this embodiment is similar to that shown in Figures 1 and 2 in that it comprises four pairs of twisted wires 20 and a cross-shaped filler 22 disposed in an outer sheath 21, the filler 22 having points of weakness 23

spaced along its length.

Where this embodiment differs is that it additionally includes two insulating and/or screening layers 24 disposed around the four twisted pairs 20 and filler 22, under the outer sheath 21.

Referring to Figures 4 and 5 another embodiment comprises six helically assembled cable components 30, which could be insulated wires, optical fibres or some other component or combination of components, surrounding a central filler 31. The filler could be formed from plastic, string or some other suitable material. The cable components 30 and filler 31 are surrounded by a plastic outer sheath 32.

At regular intervals along the length of the cable points of weakness are formed in the filler 31, at which it will preferentially break when placed under tension. Each point of weakness comprises a region of reduced cross-section, which may be formed by partially cutting through the filler. The location of each point of weakness is indicated by an "X" in Figure 4. The outer sheath could be marked to show the position of the points of weakness.

The cable is shown with part of the outer sheath 33 removed, to enable the cable components 30 to be terminated. Before doing so excess filler 31 must be removed. This is achieved by pulling the exposed end of the filler 31 away from the cable whereupon it will break at a point of weakness, most probably that nearest the end of the filler.

In all the illustrated embodiments the points of weakness could be replaced with discontinuities in the filler.

Figure 6 shows apparatus to introduce points of weakness into a cable filler.

Filler enters the apparatus through a die 40 and then proceeds between two sets of wheels 41 with blades 42 disposed around their periphery. The blades 42 will cut into opposite sides respectively of the filler. The two sets of wheels are disposed at right angles to each other, so that upon passing through the apparatus, cuts will be made into the filler from four perpendicular directions. The filler leaves the apparatus through a second die 43.

Provision 44 is made to allow adjustment of the relative position of the cutter wheels.

The blade wheels 41 are driven by servo controlled motors 45 and may be controlled from an encoder driven by the filler as it passes through the machine.

The above embodiments are described by way of example only, many variations are possible without departing from the invention. For example, additional components can be laid under the outer sheath of the cable, for example longitudinal wires to assist earthing/screen connection and/or kevlar (RTM) string/tape to provide mechanical protection and longitudinal strength. The weaknesses or discontinuities in the filler could be introduced

by non-mechanical means, for example with a laser.

CLAIMS

1. A cable comprising a filler having a plurality of points of weakness or discontinuities spaced along its length.

2. A cable as claimed in claim 1, wherein the points of weakness or discontinuities are evenly spaced.

3. A cable as claimed in either claim 1 or 2, wherein the points of weakness or discontinuities lie at intervals of between 10 and 50mm.

4. A cable as claimed in any preceding claim, wherein the outside of the cable is marked to indicate the locations of the points of weakness or discontinuities in the filler.

5. A cable as claimed in any preceding claim, wherein the points of weakness or discontinuities are formed by partially or fully cutting through the filler.

6. A cable as claimed in any of claims 1 to 4, wherein points of weakness are formed by perforating the filler.

7. A cable as claimed in any preceding claim, wherein the filler comprises a plastics material.

8. A cable as claimed in any preceding claim, wherein the filler is shaped, in cross-section, to have a number of arms to enable it to separate other cable components.

9. A cable as claimed in claim 8, wherein the filler is cross-shaped in cross-section.

10. A cable as claimed in any preceding claim, wherein the filler is electrically conductive or semi-conductive.

11. A cable as claimed in any preceding claim comprising a plurality of twisted pairs of insulated wire.

12. A cable as claimed in claim 11, wherein an electromagnetic screen is provided around at least one of the pairs of twisted wire.

13. A method of manufacture of a cable comprising the steps of providing a filler and partially or wholly cutting through the filler at points along its length to form points of weakness or discontinuities along is length.

14. A method as claimed in claim 13 comprising the step of encapsulating the filler together with other cable components in an outer sheath.

15. A method of preparing a cable as claimed in any of claims 1 to 12 for installation, comprising the step of pulling on the filler to remove a portion of the filler up to a point of weakness or discontinuity.

16. A method as claimed in claim 15, wherein the filler is removed up to the first point of weakness or discontinuity from the point at which it is pulled.

17. A method as claimed in either claim 15 or 16, wherein the cable includes an outer sheath and further comprising the step of stripping off a portion of the outer sheath to expose a portion of the filler at

the end of the cable and wherein the exposed portion of the filler is pulled to remove a portion of the filler.

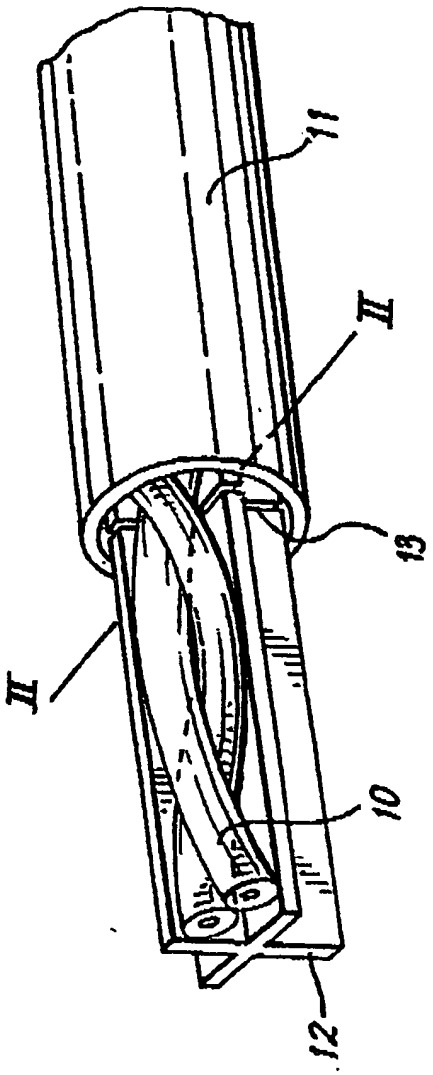


Fig.1

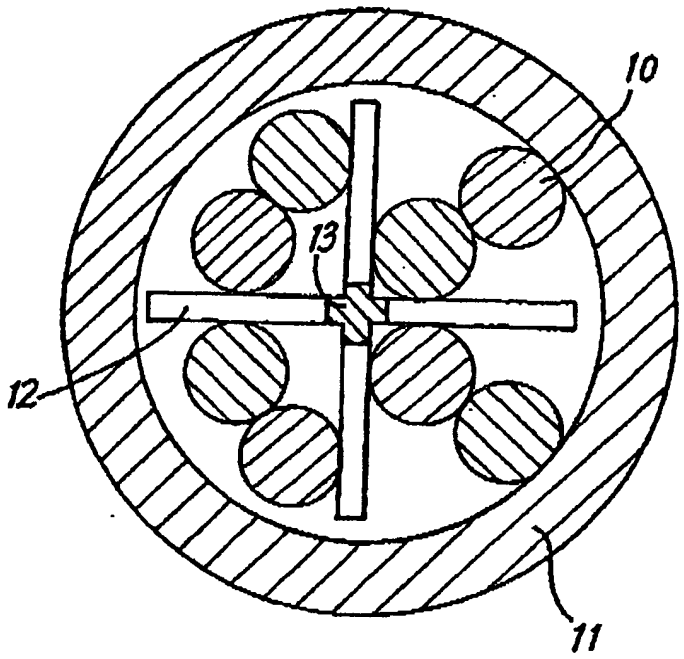


FIG. 2

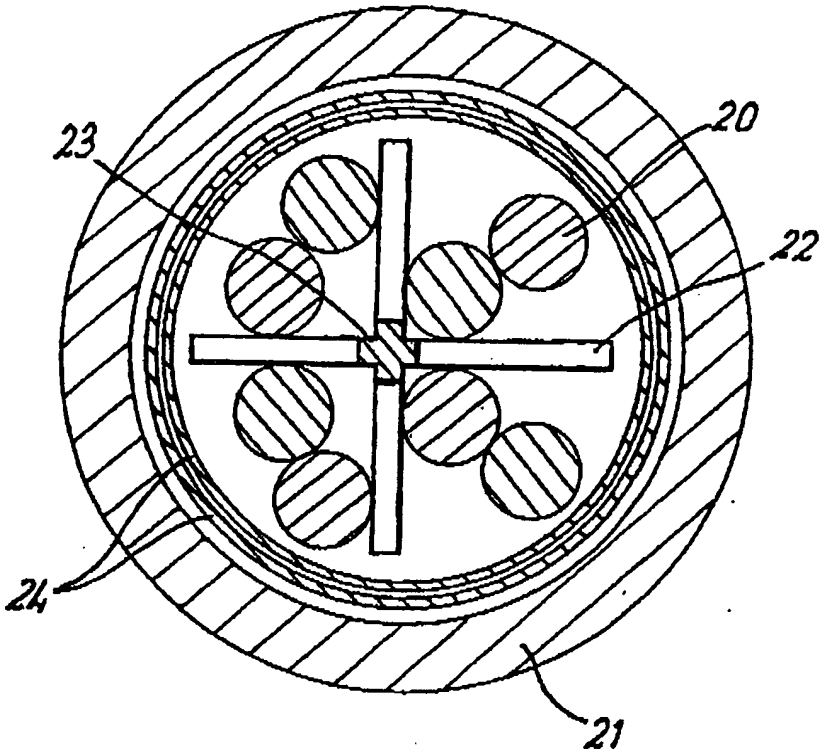


FIG. 3